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ABSTRACT

Metacognitive knowledge is the concern of this paper: specifically children's knowledge of factors, such as their ability and effort, which affect their performance and their awareness of the integration of these factors. How a young child's familarity with his or her own mind might facilitate reasoning competence with respect to aspects--such as ability and effort--of a mental task like reading words, is examined. Results showed that children do seem able to reason in a relatively sophisticated way about the separate and combined effects of their mental ability and effort on their success and failure. They are able to discriminate attributions, consider the negation and reciprocal relationships among the attributes separately, and integrate them. (Author/GK)

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Structure of Children's Attributes of School Success and Failure

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Studies of metacognition have provided a wealth of knowledge about children's understanding of their mental processes, particularly those such as memory, attention, comprehension and studying, which play such a large role in schooling. For example, as children progress through elementary school, they become increasingly planful when faced with a memory problem and are increasingly able to generate a greater range of mnemonic strategies to aid their recall (Kreutzer, Leonard, & Flavell, 1975). During the elementary school years, children also become more realistic in their estimates of the effect of time delay on their recall, and the degree of interaction between such variables as time delay and number of items to remember (Wellman, 1978). Moreover, they increasingly understand the limits on their recall of simply trying harder to remember (Wellman, Collins, & Gleiberman, 1979). By third grade, a child is quite accurate in monitoring his memory and predicting whether an item is in his memory or not (Wellman, 1977).

With regard to attention and study skills, Bisanz, Vesonder, and Voss (1978) have found that although third

graders were able to discriminate items that they recalled correctly and incorrectly, it was not until fifth grade that they could use that information to selectively study the incorrect items. Brown and Smiley (1978) also found that most students below fifth grade could not effectively direct their attention to study the most informative elements of prose passages. Miller and Bigi (1979) found children from first to fifth grade become increasingly aware of psychological variables such as confusion, disinterest, and daydreaming that influence their attention. Moreover, young children also have difficulty realizing that they cannot comprehend certain distorted and incomprehensible sentences (Markman, 1977). In general, then, during the elementary school years children come to learn much about some of their own cognitive processes.

Much of what they know falls into one of the five categories defined by Wellman (in press). First is the child's knowledge that mental processes exist both for the self and for others; second is their understanding that there are distinct mental processes, e.g., attention and memory; third, is their knowledge of certain variables which influence mental states or performance; and, fourth, is their knowledge that mental processes can be integrated, such as the effect of imagery and rehearsal on memory. Finally, the child recognizes that he can monitor his mental states or processes.

In this study, we are concerned with only the third and fourth types of metacognitive knowledge--children's knowledge of factors, such as their ability and effort, which affect their performance and their awareness of the integration of these factors.

Fifth and sixth grade students can identify many variables that affect their success and failure on school tests (Bar-Tal & Darom, 1979), the four major ones being their ability, their effort, task difficulty and luck. Children's understanding of and reasoning about these factors as causes of other people's success and failure becomes progressively more logical with age (Kun, 1977; Kun, Parsons, & Ruble, 1974; Nicholls, 1978; Smith, 1975; Schultz, Butkowsky, Pearce, & Shanfield, 1975). Eight year olds' perception of their attainment, for example, was not found to be logically related to the attributions they made about their own success or failure (Nicholls, 1979). Since ability and effort appear to be the most salient and general of the causes children have identified for their own and others success and failure (Weiner, 1979), the child's awareness of these two variables and the development of the integration was explored.

It would be expected that children's thinking about their own mental processes would be constrained by the same factors which limit their thinking about everything else.

At the same time, it is well established that familiarity with task and problem elements facilitates children's and adult's reasoning about them. Thus, we might expect that the child's reasoning about his own mind and its attributes could show greater sophistication than his reasoning about other things with which he is markedly less familiar.

This study also examined how the young child's great familiarity with his own mind, particularly the distinction he might make between his ability and effort, might facilitate his reasoning competence with respect to these two aspects of a mental task like reading words. Can the child's reasoning about success and failure, for example, be analyzed in terms of the constraints of the stages of the Genevan operativity model? It may make sense to consider the structure of the attributes, effort and ability as a INRC group in which high effort is negated obviously by low effort and high ability by low ability; in which high effort compensates low ability, and so forth (Figure 1). In this study the child's being older, and presumably having more reading ability, and his trying were taken as correlates in the formal operational sense of the INRC group. We hypothesized that the concrete operational child's privileged position as a knower of himself might allow him to simultaneously evaluate the effects of two familiar attributes of himself, namely, his ability and his effort, on an ordinary school task (reading words).

To answer these questions children were asked to read and define two lists of three words each. One set was constructed so the children would succeed and the other so they would fail. They were then asked a series of questions about how they would do under other circumstances, i.e., if they were older and knew more words, if they were younger but tried harder, etc. A sample of adults completed a questionnaire with similar questions about how the children would perform to determine if the children reason about themselves as the adults reason about the children.

Method

Subjects

Subjects were 20 second and 20 third graders (21 girls, 27 whites, ranging from 7 years, 6 months to 9 years, 11 months) randomly selected from a suburban, desegregated Delaware elementary school. In addition, 40 sophomores in College of Education educational psychology and educational research classes comprised the adult sample.

Stimulus Materials

The materials were three sets of 10 lower case words with each word on a 4 x 7 index card. The word lists, with few exceptions were the same for the two grade levels. One list at each grade level contained words at or one grade level below the child's and were "easy" to define and pronounce for children in a pilot test. A second list contained words

at or one grade level above the students and were "hard" to define and pronounce for children in a pilot test. The lists of words were:

2nd and 3rd grade, easy: chipmunk, footsteps, helpful, ladder, pancake, remember, shirt, skate, supermarket, wagon

2nd grade, hard: bounded, follicles, gnash, minced, opinion, orchard, scent, strategy, touring, patient

3rd grade, hard: affliction, beholden, bounded, follicles, gnash, minced, opinion, orchard, rheumatism, strategy

Procedure

Children were told that they would be asked to read and define words that might be found in a second (or third) grade reader. They were told that some words would be easy, but others would be hard but they should try to do their best. They were also told that they would be asked some questions about how they did with the words.

Subjects were then presented with three randomly chosen words one at a time from one of the lists (half received the easy words first). After they pronounced and defined each word, they were told either: "Very good; You're close, the word is _____; You said it right, but it means _____; You're close, _____ means _____." After all three words they were

told: "Good, you made no (hardly any) mistakes;" or "Well, it looks like you made quite a few mistakes with these words." They were then asked the following questions:

1. Why do you think you did well (poorly)?
2. What does that mean?
3. Could it mean that you tried hard, were smart, just knew the words, or were lucky?
4. Can you tell me more?
5. Could there be another reason why?
6. Could it be because you tried hard, were smart, just knew the words, or were lucky?

(The negative version was used in the failure condition.)

They were then asked the following eight questions in random order:

1. What if you were older and knew more, could you have read them then?
2. What if you were younger and didn't know as many words, could you have read them then?
3. What if you tried harder, could you have read them then?
4. What if you didn't try, could you have read them then?
5. What if you were older and knew more and you tried hard, could you have read them then?
6. What if you were older and knew more and you didn't try, could you have read them then?

7. What if you were younger and didn't know as many words and you tried hard, could you have read them then?

8. What if you were younger and didn't know as many words and you didn't try, could you have read them then?

The second list was then presented and the procedure repeated.

The adults received a questionnaire describing the experiment with the children and were asked to answer the above eight questions as they thought the children would in both the success and failure conditions.

Results and Discussion

Because significant differences were not found between second and third graders in any of the analyses, the data of the two groups were combined in the analyses which follow.

The data in Table 1 indicate that the children were able to identify the variables that affect their success and failure. Their initial attributions were primarily task attributions (46% to 58% said the words were easy). Their own effort was the next most common cause of their success (40% of the responses). When asked for a second response, the subjects evenly divided their answers among the four types of attributions. From the total responses, when they succeed in reading a word they were most likely to attribute

their success to their effort (33%) or task difficulty (37%). When they failed to read a word they were most likely to attribute their failure to task features (40%).

The results also provide evidence that the children treated the negation and reciprocal relationships among the four attributes consistently (see Figure 1). Six McNemar Analyses of changes, or shifts, in children's predictions of their ability to read words between the negations (old vs. young, try vs. don't try) and between the reciprocals (old vs. don't try, try vs. young) were significant in each condition ($p < .008$, and determined by .05 divided by six tests). The shifts between the correlates (old and try, young and don't try), were not significantly different ($p > .008$) in the success condition, but in the failure condition "young vs. don't try" was significant ($p < .008$). The children realized that they would not do well if they were younger or indolent and that their being older or their trying harder were conditions for success. Furthermore, the correlates, ability and effort, were considered approximately equal in their effects on their performance except in the failure condition where not trying had a significantly poorer prognosis than simply being younger ($p < .008$).

Not only did the child distinguish the negation, reciprocal and correlate relationships among the attributes, but he seemed to integrate the attributes also. On one level, the

simple proportions (Figures 2 & 3) of children who thought they could read the words in the combined conditions (e.g., old and don't try, young and don't try) falls in between that of the single attributes. On the other hand the proportion of children who thought that being both younger and not trying would still enable them to read the words was less than the proportions who thought they should be able to read the words if they were younger or if they didn't try. The combined correlate "old and try" was prevented from being higher than either attribute alone by a ceiling effect.

On another level, the eight McNemar analyses of the changes in the child's prediction of his success in reading a word between a single attribute condition and a combined attribute condition, as well as the five analyses between two combinations of attributes, gave evidence of the child's ability to integrate the attributes of his mental processes in the manner suggested in Figure 2. The combined correlates (old and try, young and don't try) were not different from any individual attribute ($p = .006$, α determined by .05 divided by 8 tests), with one exception (young vs. young and don't try in Figure 2). Ceiling and floor effects are quite probable in these cases. Evidence for integration is also given by the differences between the single attributes and combined reciprocals. McNemar analysis of "old vs. old and don't try" and "young vs. young and try" were

significant ($p = .006$) in the success condition (Figure 3). In failure (Figure 2), "old and don't try" was significantly different from either attribute alone and "young and try" was significantly different from "try" ($p = .006$).

Evidence for the integration of attributes was further provided by the significant differences between the combined correlates (old and try, young and don't try) and the reciprocals (old and don't try, young and try) ($p = .01$, α determined by .05 divided by 5 tests), in the failure condition and two of the four comparisons in success. Even further the expectation that the two reciprocals should be the same was upheld in the failure condition ($p = .01$).

At times the integration of ability and effort was characterized by a disproportionate effect of effort. The significant difference between "young" and "young and don't try" and the nonsignificant difference between "young" and "young and try" suggests that low ability is not weighted as heavily as low effort in failure. In addition, the non-significant differences in the success condition (don't try vs. older and don't try, try vs. younger and try, older and try vs. younger and try, and older and don't try vs. younger and don't try) reflect the greater weight given to effort. Finally, the significant difference between "older and don't try" and "younger and try" (Figure 3) reflects the greater emphasis of effort relative to ability. In other words, the

children believed they were more likely to succeed if they tried harder than if they were older and knew more.

Adults were asked to answer the eight hypothetical questions as they thought the children would. Their answers were remarkably similar to the children's. The Chi-square analyses between adult and child responses were not significant for any of the eight questions ($p = .006$, $df = 1$) in either the success or failure condition. Furthermore, the pattern of significant McNemar analyses was substantially the same in each condition. Only four of the 19 comparisons in the success condition and five of the 19 comparisons in the failure condition were reversed. Those differences reflect the greater weight the children gave to effort. The adult data was more consistent with the balanced integration suggested by an INRC group of the factors.

Conclusions

These young children do seem to be able to reason in a relatively sophisticated way about the separate and combined effects of their ability and effort on their success and failure. They are able to discriminate attributions, and their attributions are similar in success and failure. This is consistent with Nicholls (1979) finding that young children's attributions do not differ according to their perceived attainment. These second and third graders can also consider the negation and reciprocal relationships

among the attributes separately, and they can integrate them. This is consistent with Kun, Parsons, and Ruble's (1974) finding that children as young as second grade could integrate ability and effort information to predict someone else's task performance. Kun, et al's (1974) evidence for a multiplicative rule, that effort is more facilitative for high than low ability, is unsubstantiated. In this study the integration is characterized by a disproportionate effect of effort.

The substantial similarity with the adults' reasoning about the childrens' performance lends further credence to the conclusion that these children are reasoning in a relatively sophisticated way.

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Table 1

Percentages of Children Who Made Various Types of Attributes in Response to Why They Succeeded or Failed (n=40)

Types of Attributions	Question Condition					
	Initial		Second		Total	
	S	F	S	F	S	F
Ability	.10	.02	.22	.05	.16	.03
Effort	.40	.12	.25	.15	.33	.14
Task Difficulty	.46	.58	.28	.22	.37	.40
Luck	.02	.16	.15	.20	.08	.18
Other[1]	.02	.12	.10	.38	.06	.25

Initial includes those children who responded spontaneously and those who were given a choice of responses if they did not respond spontaneously.

Second is a second attribution the children gave.

[1]Other is composed of "don't know's," "I guessed," and no response.

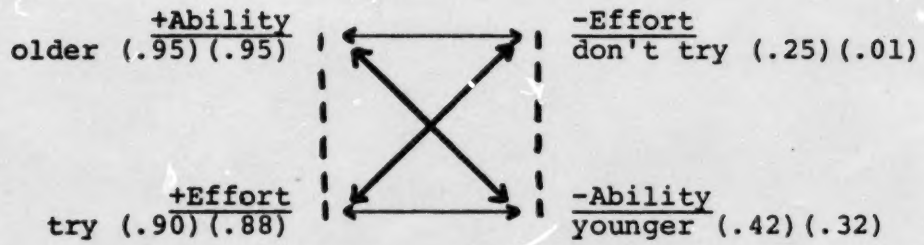

Figure 1

Proportions of children in each single attribute condition who said they would be able to read the word again after having successfully read it (or in second parenthesis, after having failed to read it). Solid lines indicate significant shifts in proportions of children who thought they could read a word between one condition and another after they succeeded.

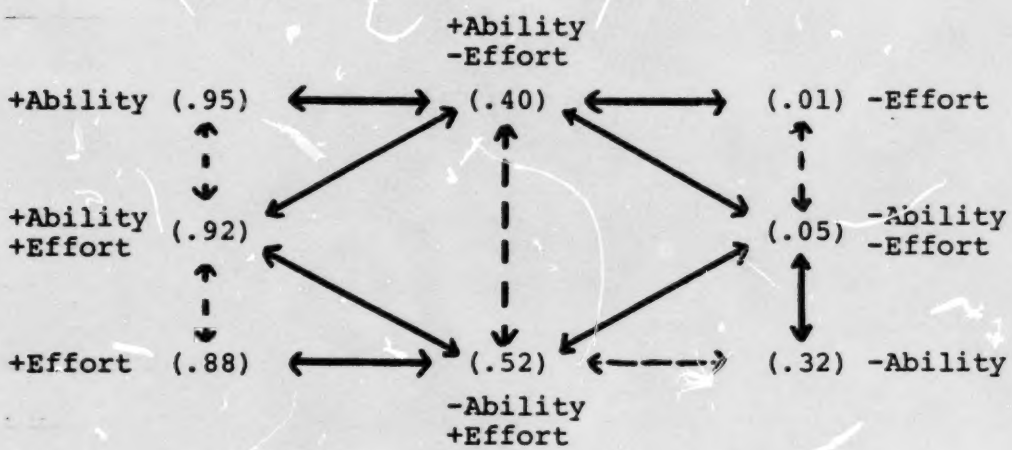

Figure 2

Proportions of children in single and combined attribute conditions who said they would be able to read words they had just failed to read. Solid lines portray significant McNemar proportions.

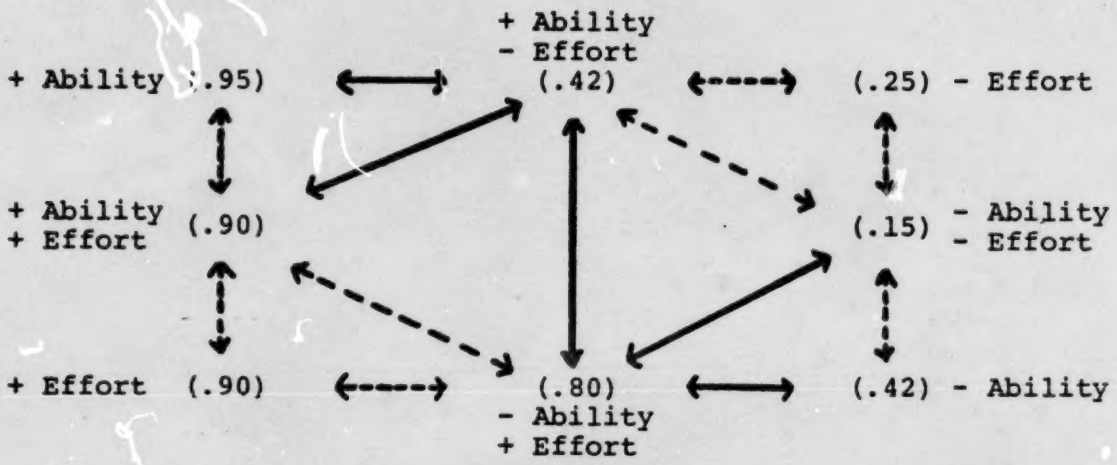

Figure 3

Proportions of children in single and combined attribute conditions who said they would be able to read words they just read. Solid lines portray significant McNemar proportions.